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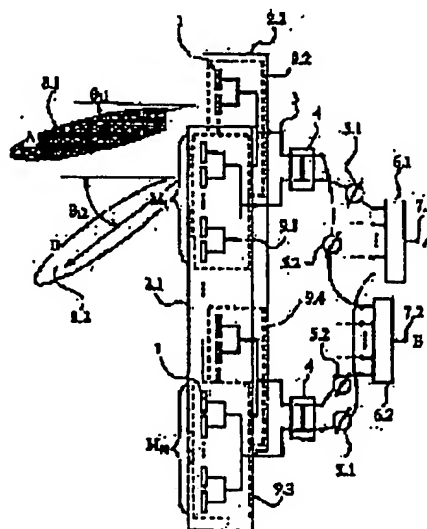
(54) BEAM TILT ANTENNA

(57)Abstract:

PURPOSE: To form two beams separately radiating on a horizontal plane and to independently set up tilt angles in a vertical face by the two beams.

CONSTITUTION: Two adjacent arrays of the 1st and 2nd array antennas 2.1, 2.2 having almost the same constitution are arranged, N hybrid circuits 4 including the 1st and 2nd antenna side terminals and the 1st and 2nd device side terminals are connected to the arrays and the two antenna side terminals of the circuit 4 are provided with branch/coupling characteristics for outputting signals whose phases are mutually different by 90° correspondingly to a signal outputted from one of the device side

terminals. This beam tilt antenna is also provided with the 1st and 2nd phase shifters 5.1, 5.2 and the 1st and 2nd power distributors 6.1, 6.2 each of which has N terminals on the antenna side and one terminal on the device side. The beam tilt angles of beams A, B depend respectively on the values of the phase shifters 5.1, 5.2.



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CLAIMS

[Claim(s)]

[Claim 1] It has the first and the second power distribution unit which are characterized by providing the following. Two antenna elements which adjoin the horizontal direction of said first and the second array antenna are alike, respectively, and the first [of the hybrid circuit of said N individual] and second antenna side edge children are connected, respectively. The first equipment side edge child of the hybrid circuit of the N individual is connected to said first power distribution unit through said first phase shifter, respectively. The beam tilt antenna characterized by connecting the second equipment side edge child of the hybrid circuit of the N individual to said second power distribution unit through said second phase shifter, respectively. The first array antenna with which the antenna element of N individual (N is even number) was arranged in the direction of a vertical It is arranged like. this first array antenna -- almost -- the second array antenna of the same configuration -- 2 train next door **** -- Have two or more hybrid circuits of N individual, and this hybrid circuit contains the first and second antenna side edge children and firsts, and second equipment side edge children, respectively. And it has the branching joint property which serves as a signal with which phase shifts differ 90 degrees mutually to the two antenna side edge child about one signal of the equipment side edge child, and is the first phase shifter of N individual. The second phase shifter of N individual It has the terminal of N individual in an antenna side, respectively, and is one terminal to an equipment side.

[Claim 2] Said antenna element is a beam tilt antenna containing two or more radiating elements according to claim 1, respectively.

[Claim 3] It has the first and the second power distribution unit which are characterized by providing the following. Two antenna elements which adjoin the horizontal direction of said first and the second array antenna are alike, respectively, and the first [of the hybrid circuit of said N individual] and second antenna side edge children are connected, respectively. While the first equipment side edge child is mutually combined about every two concerning the antenna element which adjoins among the hybrid circuits of the N individual, it connects with said first power distribution unit through said first phase shifter. The beam tilt antenna characterized by connecting with said second power distribution unit through said second phase shifter while the second equipment side edge child was mutually combined about every two pieces which adjoin among the hybrid circuits of the N individual. The first array antenna with which the antenna element of N individual (N is even number) was arranged in the direction of a vertical It is arranged like. this first array antenna -- almost -- the second array antenna of the same configuration -- 2 train next door **** -- Have two or more hybrid circuits of N individual, and this hybrid circuit contains the first and second antenna side edge children and firsts, and second equipment side edge children, respectively. And it has the branching joint property which serves as a signal with which phase shifts differ 90 degrees mutually to the two antenna side edge child about one signal of the equipment side edge child, and is the first N/2 phase shifter. The second N/2 phase shifter It has N/2 terminal in an antenna side, respectively, and is one terminal to an equipment side.

[Claim 4] The first and the second power distribution unit which are characterized by providing the

following, It has the third and fourth power distribution units which have two or more terminals in an antenna side, respectively, and have one terminal in an equipment side. Two antenna elements which adjoin the horizontal direction of said first and the second array antenna are alike, respectively, and the first [of the hybrid circuit of said N individual] and second antenna side edge children are connected, respectively. About every two concerning the antenna element which adjoins among the hybrid circuits of the N individual The first equipment side edge child is connected to the antenna side edge child of said third power distribution unit, respectively. The beam tilt antenna characterized by having connected the second equipment side edge child to the antenna side edge child of said fourth power distribution unit, respectively, and connecting each equipment side edge child of the third and fourth power distribution units to said first and second power distribution unit through the first and the second phase shifter, respectively The first array antenna with which the antenna element of N individual (N is the multiple of 4) was arranged in the direction of a vertical It is arranged like. this first array antenna -- almost -- the second array antenna of the same configuration -- 2 train next door

**** -- Have two or more hybrid circuits of N individual, and this hybrid circuit contains the first and second antenna side edge children and firsts, and second equipment side edge children, respectively. And it has the branching joint property which serves as a signal with which phase shifts differ 90 degrees mutually to the two antenna side edge child about one signal of the equipment side edge child, and is the first phase shifter. The second phase shifter It has two or more terminals in an antenna side, respectively, and is one terminal to an equipment side.

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CLAIMS

[Claim(s)]

[Claim 1] It has the first and the second power distribution unit which are characterized by providing the following. Two antenna elements which adjoin the horizontal direction of said first and the second array antenna are alike, respectively, and the first [of the hybrid circuit of said N individual] and second antenna side edge children are connected, respectively. The first equipment side edge child of the hybrid circuit of the N individual is connected to said first power distribution unit through said first phase shifter, respectively. The beam tilt antenna characterized by connecting the second equipment side edge child of the hybrid circuit of the N individual to said second power distribution unit through said second phase shifter, respectively. The first array antenna with which the antenna element of N individual (N is even number) was arranged in the direction of a vertical It is arranged like. this first array antenna -- almost -- the second array antenna of the same configuration -- 2 train next door **** -- Have two or more hybrid circuits of N individual, and this hybrid circuit contains the first and second antenna side edge children and firsts, and second equipment side edge children, respectively. And it has the branching joint property which serves as a signal with which phase shifts differ 90 degrees mutually to the two antenna side edge child about one signal of the equipment side edge child, and is the first phase shifter of N individual. The second phase shifter of N individual It has the terminal of N individual in an antenna side, respectively, and is one terminal to an equipment side.

[Claim 2] Said antenna element is a beam tilt antenna containing two or more radiating elements according to claim 1, respectively.

[Claim 3] It has the first and the second power distribution unit which are characterized by providing the following. Two antenna elements which adjoin the horizontal direction of said first and the second array antenna are alike, respectively, and the first [of the hybrid circuit of said N individual] and second antenna side edge children are connected, respectively. While the first equipment side edge child is mutually combined about every two concerning the antenna element which adjoins among the hybrid circuits of the N individual, it connects with said first power distribution unit through said first phase shifter. The beam tilt antenna characterized by connecting with said second power distribution unit through said second phase shifter while the second equipment side edge child was mutually combined about every two pieces which adjoin among the hybrid circuits of the N individual. The first array antenna with which the antenna element of N individual (N is even number) was arranged in the direction of a vertical It is arranged like. this first array antenna -- almost -- the second array antenna of the same configuration -- 2 train next door **** -- Have two or more hybrid circuits of N individual, and this hybrid circuit contains the first and second antenna side edge children and firsts, and second equipment side edge children, respectively. And it has the branching joint property which serves as a signal with which phase shifts differ 90 degrees mutually to the two antenna side edge child about one signal of the equipment side edge child, and is the first N/2 phase shifter. The second N/2 phase shifter It has N/2 terminal in an antenna side, respectively, and is one terminal to an equipment side.

[Claim 4] The first and the second power distribution unit which are characterized by providing the

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PRIOR ART

[Description of the Prior Art] In the antenna used for the base station of the land mobile radiotelephone of a cell method, in order to aim at repeat use of a frequency between cell zones, the tilt beam which made the radiation beam of an antenna bias caudad from a horizontal plane is used. It needs to be decided by the ground height and zone radius of an antenna, an include angle, i.e., a beam tilt angle, down [this], and it needs to change a beam tilt angle in the base station of height. For this reason, the antenna for base stations has composition which can carry out adjustable [of the beam tilt angle].

[0003] A concrete configuration is shown in drawing 5. In drawing 5, as for 1, the dipole antenna, the flat antenna, etc. are used by the antenna element. 3 -- a feeder way and 5.3 -- a phase shifter and 6.3 -- interblock -- as for the power distribution unit of business, and 7.3, an input terminal, and 9.5 and 9.6 are block arrays. the array antenna with which the antenna element 1 of N individual has been here arranged in a vertical plane at one train -- the block of M individual -- dividing -- each block -- respectively -- M1 from -- MM He is trying to consist of a component of an individual. Here, by changing the value of the phase shifter 5.3 connected to each block arrays 9.5 and 9.6, the excitation phase shift on an antenna element 1 is changed, and a beam direction can be set now as arbitration (Ebina, Nakajima "beam chill TEINGU angle control approach of multistage linear lei antenna" JP, 61-172411, A).

[0004] On the other hand, the technique shown in drawing 6 is known. Drawing 6 is the top view of an orientation beam. That is, if two antennas 12.1 and 12.2 arranged to juxtaposition in a horizontal plane are connected to the output terminal of a hybrid circuit 4, two beams, A and B, can be respectively obtained by electric supply from an input terminal 7.4 and an input terminal 7.5. If this technique is used, with two antennas 12.1 and 12.2, two beams of width of face narrower than the horizontal beam width of one antenna can be fabricated, and can be turned in the different direction.

[0005] Then, it is possible to make it the configuration replaced with the antennas 12.1 and 12.2 which show the array antenna shown in drawing 5 to drawing 6, as shown in drawing 7, and it becomes possible to generate two beams which leaned the beam caudad in the vertical plane by this.

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TECHNICAL FIELD

[Industrial Application] This invention is used as an antenna for base stations of mobile communication. This invention is installed in a terrestrial high location, and the orientation has an inclination towards surface of the earth, and is related with the antenna which can moreover change the inclination.

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EFFECT OF THE INVENTION

[Effect of the Invention] Two beams which are separated and emitted in a horizontal plane according to this invention as explained above are formed, each of that beam can set up a tilt angle in a vertical plane independently, thereby, it becomes possible to subdivide one cel in two or more sector zones, and to change a beam tilt angle according to an individual, a zone configuration can be formed with a sufficient precision, and a deployment of an electric wave can be performed. When this invention is carried out to mobile communication, it is effective in circuit capacity being sharply expandable.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] In order to generate two beams in such circuitry, it must be the same as the tilt angle within the vertical plane of two antennas 12.1 and 12.2 shown in drawing 5 shows with the main beams 8.4 and 8.5 of drawing 7. therefore, A and B -- there is a fault which cannot change independently the tilt angle within the vertical plane of each beam.

[0007] This invention can solve such a problem, a beam tilt angle can be changed according to an individual, a zone configuration is formed with a sufficient precision, and it aims at offering the beam tilt antenna to which the circuit capacity in mobile communication is expandable.

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MEANS

[Means for Solving the Problem] The first array antenna with which the antenna element of N individual (N is even number) was arranged in the direction of a vertical, the first of this invention, It is arranged like. this first array antenna -- almost -- the second array antenna of the same configuration -- 2 train next door **** -- Have two or more hybrid circuits of N individual, and this hybrid circuit contains the first and second antenna side edge children and firsts, and second equipment side edge children, respectively. It has the branching joint property which serves as a signal with which phase shifts differ 90 degrees mutually to the two antenna side edge child about one signal of the equipment side edge child. And the first phase shifter of N individual, It has the second phase shifter of N individual, and the first and the second power distribution unit which have the terminal of N individual in an antenna side, respectively, and have one terminal in an equipment side. Two antenna elements which adjoin the horizontal direction of said first and the second array antenna are alike, respectively, and the first [of the hybrid circuit of said N individual] and second antenna side edge children are connected, respectively. It is characterized by having connected the first equipment side edge child of the hybrid circuit of the N individual to said first power distribution unit through said first phase shifter, respectively, and connecting the second equipment side edge child of the hybrid circuit of the N individual to said second power distribution unit through said second phase shifter, respectively. Said antenna element can contain two or more radiating elements, respectively.

[0009] The first array antenna with which, as for the second of this invention, the antenna element of N individual (N is even number) was arranged in the direction of a vertical, It is arranged like. this first array antenna -- almost -- the second array antenna of the same configuration -- 2 train next door **** -- Have two or more hybrid circuits of N individual, and this hybrid circuit contains the first and second antenna side edge children and firsts, and second equipment side edge children, respectively. It has the branching joint property which serves as a signal with which phase shifts differ 90 degrees mutually to the two antenna side edge child about one signal of the equipment side edge child. And the first N/2 phase shifter, It has the second N/2 phase shifter, and the first and the second power distribution unit which have N/2 terminal in an antenna side, respectively, and have one terminal in an equipment side. Two antenna elements which adjoin the horizontal direction of said first and the second array antenna are alike, respectively, and the first [of the hybrid circuit of said N individual] and second antenna side edge children are connected, respectively. While the first equipment side edge child is mutually combined about every two concerning the antenna element which adjoins among the hybrid circuits of the N individual, it connects with said first power distribution unit through said first phase shifter. While the second equipment side edge child is mutually combined about every two pieces which adjoin among the hybrid circuits of the N individual, it is characterized by connecting with said second power distribution unit through said second phase shifter.

[0010] The first array antenna with which, as for the third of this invention, the antenna element of N individual (N is the multiple of 4) was arranged in the direction of a vertical, It is arranged like. this first array antenna -- almost -- the second array antenna of the same configuration -- 2 train next door **** -- Have two or more hybrid circuits of N individual, and this hybrid circuit contains the first and

second antenna side edge children and firsts, and second equipment side edge children, respectively. It has the branching joint property which serves as a signal with which phase shifts differ 90 degrees mutually to the two antenna side edge child about one signal of the equipment side edge child. And the first phase shifter, The second phase shifter, and the first and the second power distribution unit which have two or more terminals in an antenna side, respectively, and have one terminal in an equipment side, It has the third and fourth power distribution units which have two or more terminals in an antenna side, respectively, and have one terminal in an equipment side. Two antenna elements which adjoin the horizontal direction of said first and the second array antenna are alike, respectively, and the first [of the hybrid circuit of said N individual] and second antenna side edge children are connected, respectively. About every two concerning the antenna element which adjoins among the hybrid circuits of the N individual The first equipment side edge child is connected to the antenna side edge child of said third power distribution unit, respectively. It is characterized by having connected the second equipment side edge child to the antenna side edge child of said fourth power distribution unit, respectively, and connecting each equipment side edge child of the third and fourth power distribution units to said first and second power distribution unit through the first and the second phase shifter, respectively.

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OPERATION

[Function] As shown in drawing 1, arrange the antenna element of N individual (N is even number) in the direction of a vertical, and it considers as the first array antenna. It arranges like. this first array antenna -- almost -- the second array antenna of the same configuration -- 2 train next door **** -- It has two or more hybrid circuits of N individual, and a phase shift gives the branching joint property used as a signal including the first and second antenna side edge children and firsts, and second equipment side edge children different 90 degrees mutually to the two antenna side edge child about one signal of the equipment side edge child. Furthermore, it has the first phase shifter of N individual, the second phase shifter of N individual, and the first and the second power distribution unit that have the terminal of N individual in an antenna side, respectively, and have one terminal in an equipment side. Two antenna elements which adjoin the horizontal direction of the first and the second array antenna are alike, respectively, and the first [of the hybrid circuit of N individual] and second antenna side edge children are connected, respectively. The first equipment side edge child of the hybrid circuit of the N individual is connected to the first power distribution unit through the first phase shifter, respectively, and the second equipment side edge child of the hybrid circuit of the N individual is connected to the second power distribution unit through the second phase shifter, respectively.

[0012] By adjusting the phase shifter between the output terminals which are in the same hybrid circuit side with such a configuration, respectively, two separated beams can be formed in a horizontal plane, and the tilt angle within the vertical plane which became independent with this 2 beam can be given. Moreover, it becomes possible to subdivide one array antenna in two or more antenna elements, and to change a beam tilt angle according to an individual by this, therefore a zone configuration can be formed with a sufficient precision. Electric-wave use effectiveness becomes good by this invention, and the circuit capacity in mobile communication can be expanded sharply.

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EXAMPLE

[Example] Next, this invention example is explained based on a drawing.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] Drawing showing the configuration of the first example of this invention, and the radial voice of the main beam.

[Drawing 2] The perspective view showing the stereo configuration of the first example of this invention.

[Drawing 3] Drawing showing the configuration of the second example of this invention, and the radial voice of the main beam.

[Drawing 4] Drawing showing the configuration of the third example of this invention, and the radial voice of the main beam.

[Drawing 5] Drawing showing the example of a configuration of the conventional beam tilt antenna, and the radial voice of the main beam.

[Drawing 6] Drawing showing the example of a configuration of two conventional beam antennas.

[Drawing 7] Drawing showing the example of a configuration of the tilt antenna of two beams which combined the conventional technique.

[Description of Notations]

1 Antenna Element

1a Feeder

1b Dipole antenna

1c Reflecting plate

2.1 2.2 Array antenna

3 Feeder Way

4 Hybrid Circuit

5.1-5.3 Phase shifter

10.1 6.1-6.5, 10.2 Power distribution unit

7.1-7.5 Input terminal

8.1-8.5 Main beam

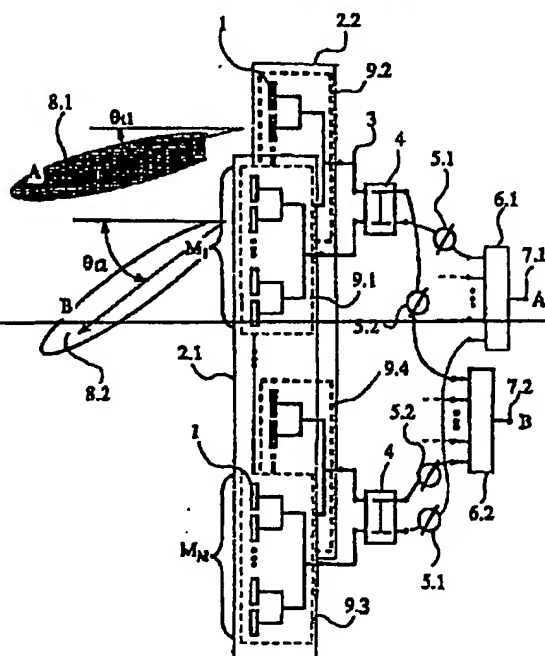
9.1-9.10 Block array

11 *****

12.1 12.2 Antenna

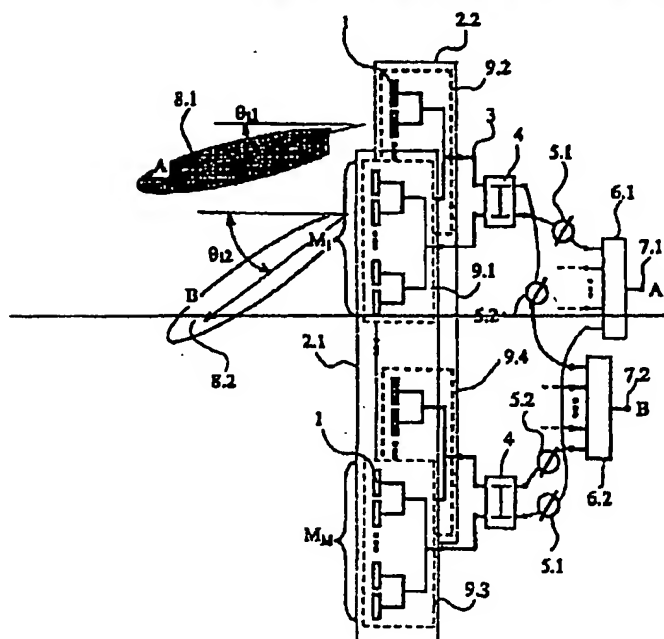
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Drawing selection Representative drawing ▾



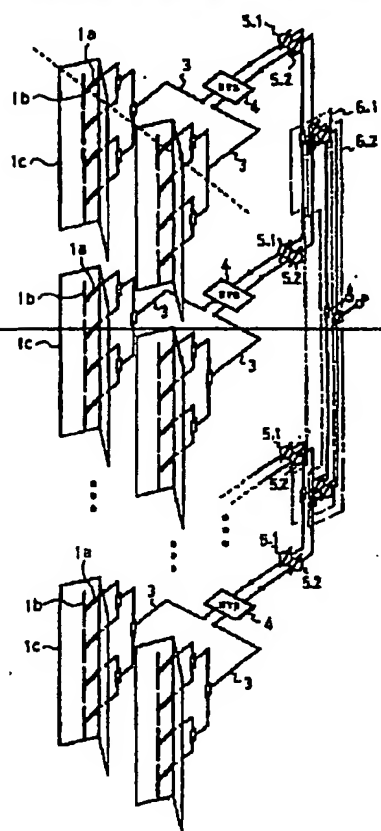
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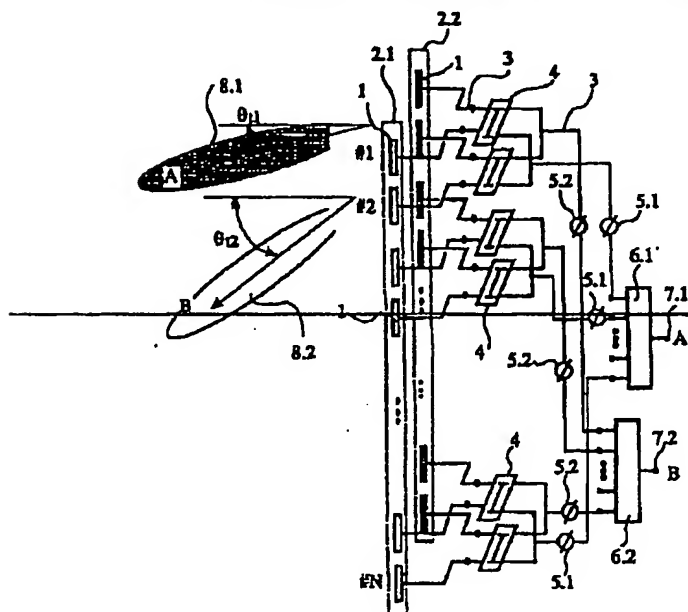
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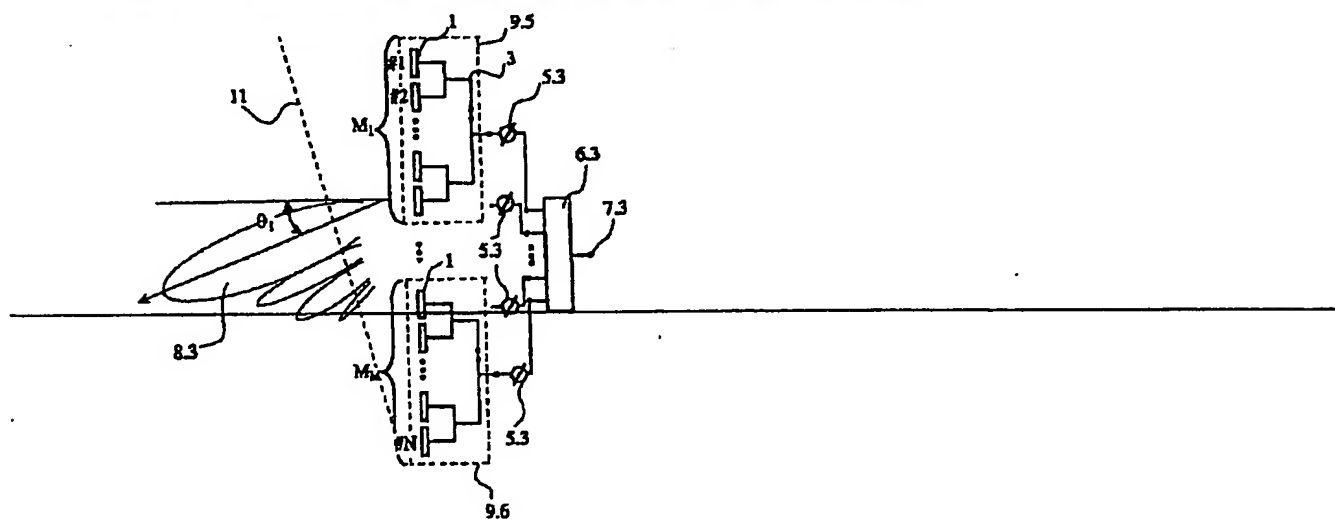
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Drawing selection drawing 3



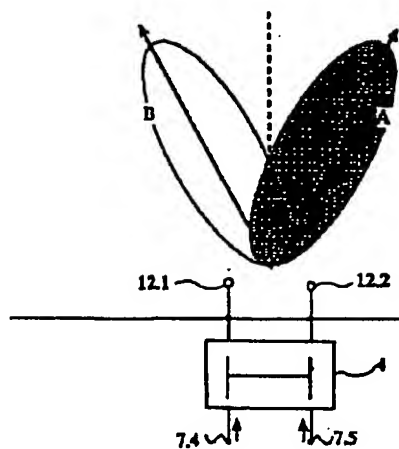
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Drawing selection drawing 5



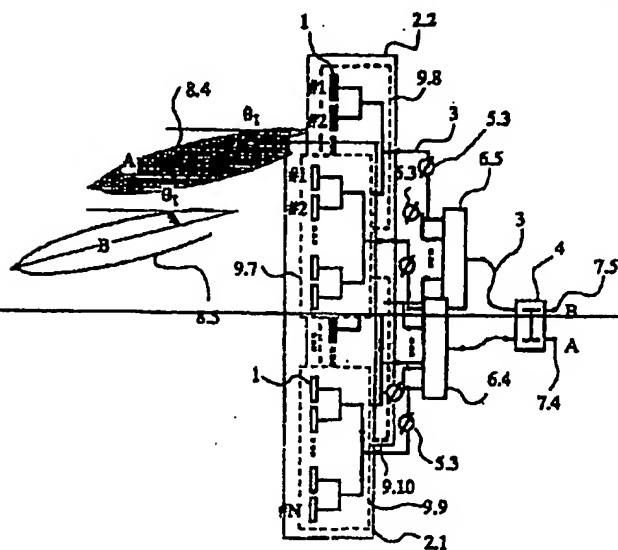
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Drawing selection



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